Cluster Management

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OSG All Hands Meeting, Boston
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About Me

- Fermilab for 10 years

- Head of Fermilab Experiments Facilities (FEF) Department in the Computing Division.

- FEF manages approx 3500 physical Linux systems: farms, workstations, online servers, offline servers, and more!

- FEF is also responsible for the development and support of Scientific Linux. **SL 6 now available!**

For this talk

- Primarily discuss Free and Open Source Software (FOSS) tools

- Tools in production at Fermilab or ones that we have recently evaluated

- "Cluster" defined as any large group of Linux systems

- Skimming the surface of cluster management

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Cluster Management Basics

- Management infrastructure

- Provisioning

- Configuration and software package management

- Monitoring

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Management Infrastructure

- Remote power-cycling and serial console access

- FEF has standardized on Avocent ACS serial console servers and Avocent PM line of PDU

- Other depts use IPMI or a mix of Avocent and APC products

- All depts have scripts to control and configure remote power-cycling and serial console access
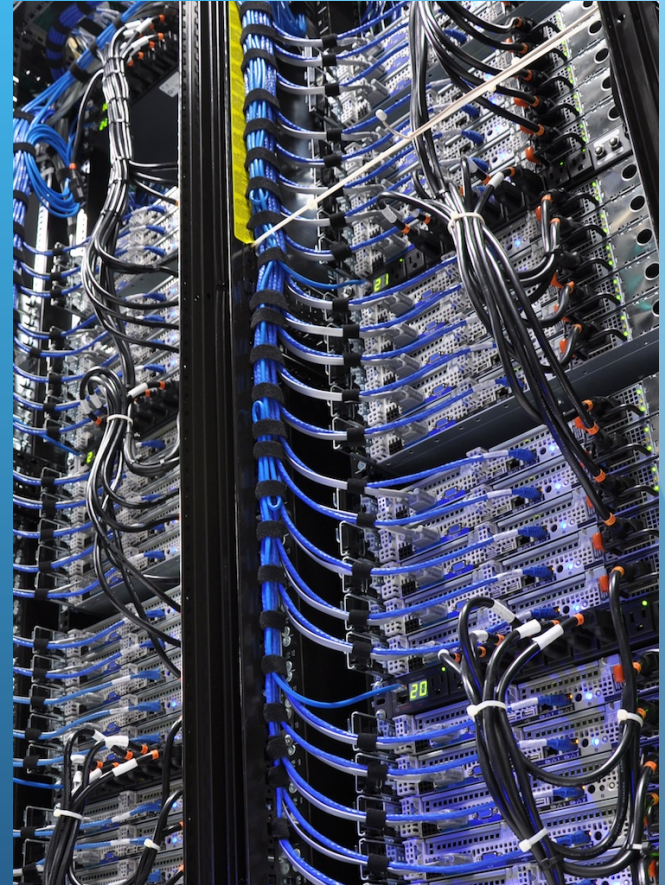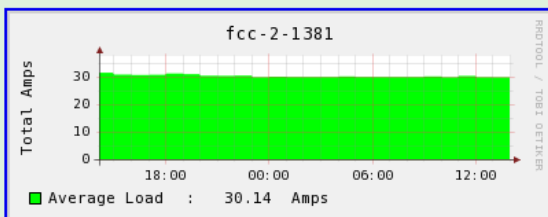
CMS Tier 1 Power Usage Plots
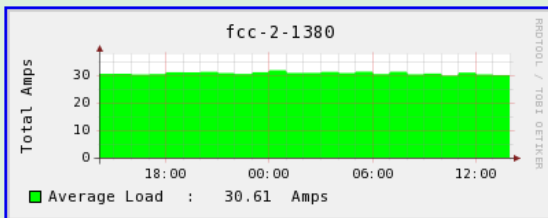
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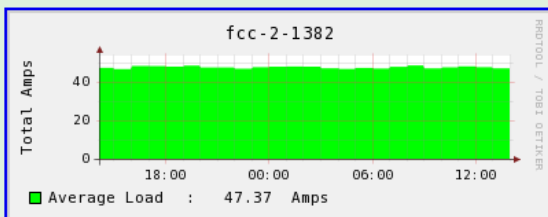
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CMS plots power utilization by querying PDUs using SNMP. This data can be particularly useful to datacenter managers.

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Provisioning Tools

Preparing a system for use; OS installation and initial configuration.

Provisioning Tools

At Fermilab

- PXE/Kickstart

- Rocks

FEF's PXE/Kickstart Setup

- FEF uses custom tool built on top of MySQL and Perl DCHP server modules.

- No dhcpd restart required.

- Web front-end for specifying kickstart / node combinations.

- Very flexible

- Kickstart files are created dynamically based on selections from the web GUI

- Planning to eval Cobbler later this year.

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Rocks Clusters

- Open source Linux distribution based on CentOS.

- Created in 2000

- Created for easy deployment of large clusters.

- Used by CMS Tier 1 at Fermilab for 2400 machines

- CMS can install ~500 systems in 1 hour.

- Only one OS version per Rocks server may be a deal breaker for some.

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Configuration and Package Management

Tools that help manage system configuration (files, dirs, permissions, etc.) and software packages.

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Configuration and Package Management Tools

Popular open source solutions:

- Cfengine

- Puppet

- Bcfg2

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Cfengine

- First version released in 1993

- Still the de facto standard configuration management tool, though Puppet is quickly catching-up

- Written in C

- Fairly easy to understand syntax

- Used by D0 workstation cluster, ClueD0

- FEF used for many years

- Relatively easy to find sysadmins with experience

Puppet

- New generation of configuration management system

- Extensible, declarative language

- Understands dependencies (huge benefit)

- Better reporting than Cfengine

- Auto generation of documentation (think Javadoc)

- FEF avg is 325 actions per node every Puppet run

FEF Puppet Usage

- Management of all external mounts

- Kerberos files -- keytab files, .k5login, etc

- Package management (RPM sets grouped by cluster)

- NIC bonding configs

- Group quotas

- Grid host certs

- FEF_backup

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Cfengine vs. Puppet (High Level)

	Native File Editing	Dependency Management	Commercial Support	Dependency Graphs	Scalability
Cfengine	✔		✔		✔
Puppet		✔	✔	✔	✔

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Puppet Add User Example

```
User { managehome    => true,
       ensure         => present,
       gid            => users,
       shell          => "/bin/bash",
}

user { "mark":
    uid => 1000,
}

user { "fred":
    uid  => 1001,
}

user { "jane":
    uid => 1002,
}
```

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Cfengine Add User Example

```
"pw[mark]" string => "mark:x:1000:100:Mark Burgess:/home/
mark:/bin/bash";

"pw[fred]" string => "fred:x:1001:100:Right Said:/home/
fred:/bin/bash";

"pw[jane]" string => "jane:x:1002:100:Jane Doe:/home/
jane:/bin/bash";

"users" slist => getindices("pw");

files:

  "/etc/passwd"

    edit_line => append_users_starting("addusers.pw");

  "/etc/group"

      edit_line => append_user_field("root","4","@
(addusers.users)");

  "/home/$(users)/."

    create => "true",

     perms => mog("755","$(users)","users");
```

Example Puppet Dependency Graph
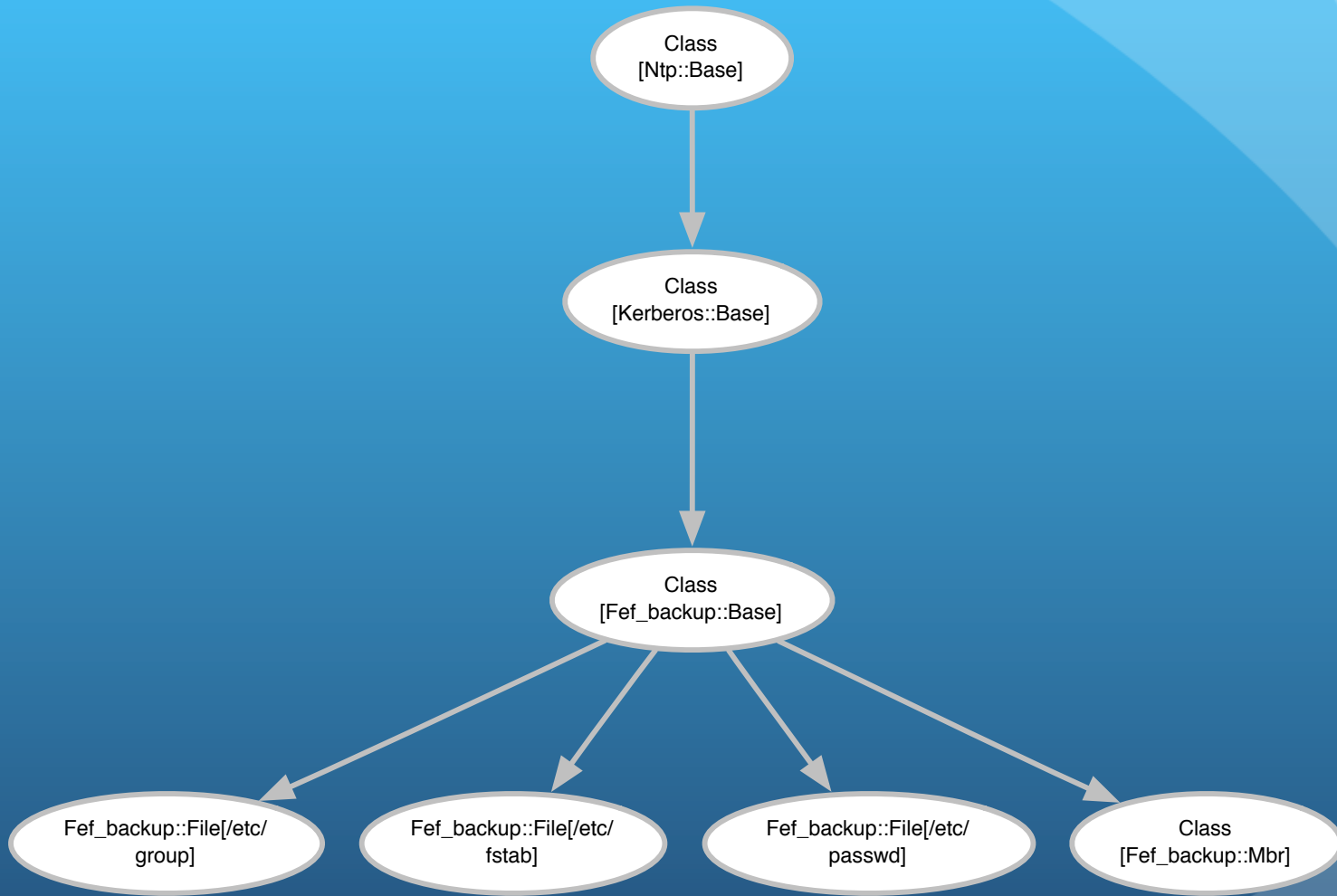
Puppet Dashboard
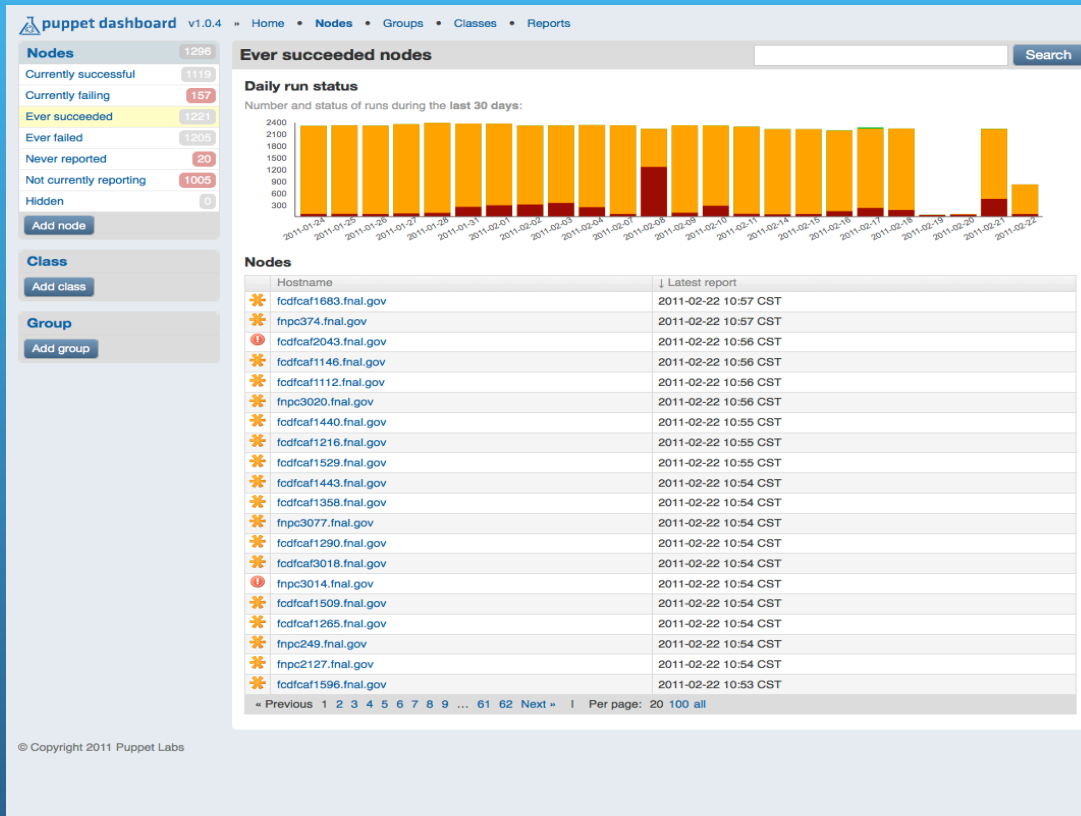
Puppet dashboard is a web interface for quickly viewing puppet run status and the state of individual system configurations.

Bcfg2

- BCFG2 is an xml-based configuration management system

- Developed by Argonne National Lab

- Being used by CMS Tier 1 at Fermilab for 2 years to manage a limited number of configuration items. Not RPMS

- Developers are very responsive; provide support via mailing list and IRC

- Complex file manipulation can be tricky

- Does simple pre/post dependencies

Bcfg2 Reporting System

Node status and last run times are viewable from the Bcfg2 web interface.

Monitoring

Tools to help monitor system state and performance.

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Monitoring

In use at Fermilab:

- Zabbix

- Nagios

- Ganglia

- Many custom solutions using MRTG, RRDtool, etc

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Zabbix

- Being used by CMS Tier 1 to monitor approx 2.4K nodes; performs 100K checks.

- Does status and performance monitoring.

- Relatively new compared to Nagios.

- Most configuration is done via the web interface.

- Easy to add custom checks and alerts.

Zabbix Dashboard

Zabbix provides a polished web interface that displays finely grained status and performance information.
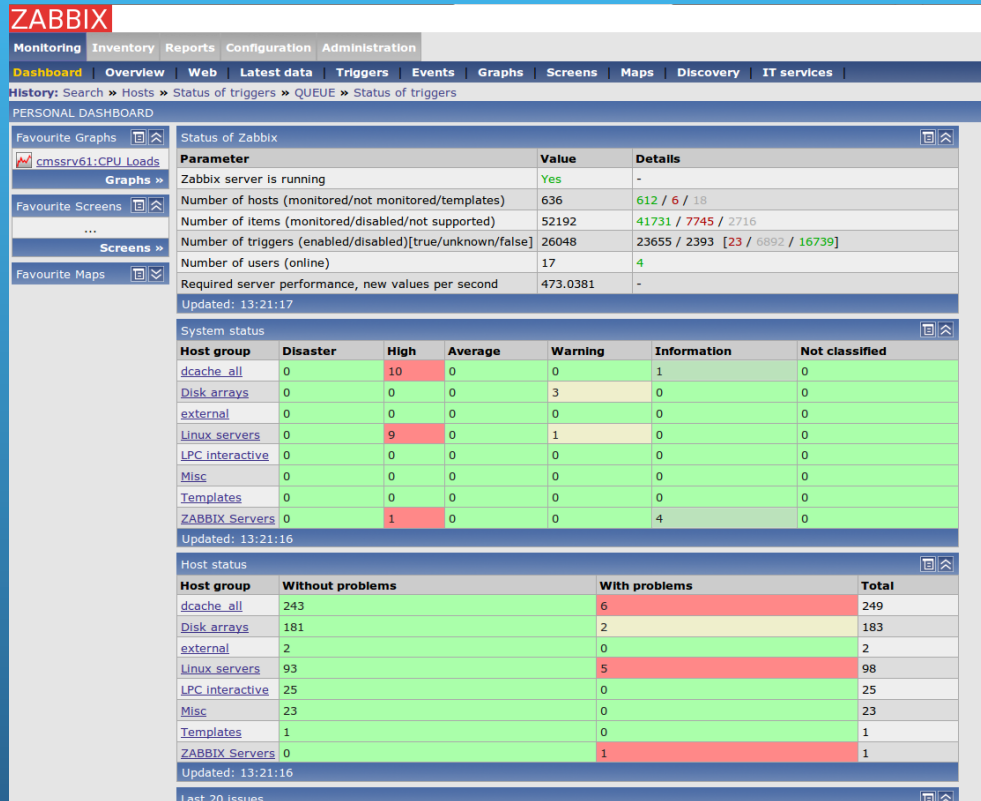
Nagios

- Used by FEF; 3.5K nodes, approx 30K checks on one server

- Around for many years.

- Create a new check by dropping shell script on node (check_mk plugin)

- Nagios support built-in to Puppet.

- Web interface can be slow and feels dated.

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Nagios Web Interface

The Nagios web interface is functional but feels dated. Performance is an issue when monitoring many hosts.
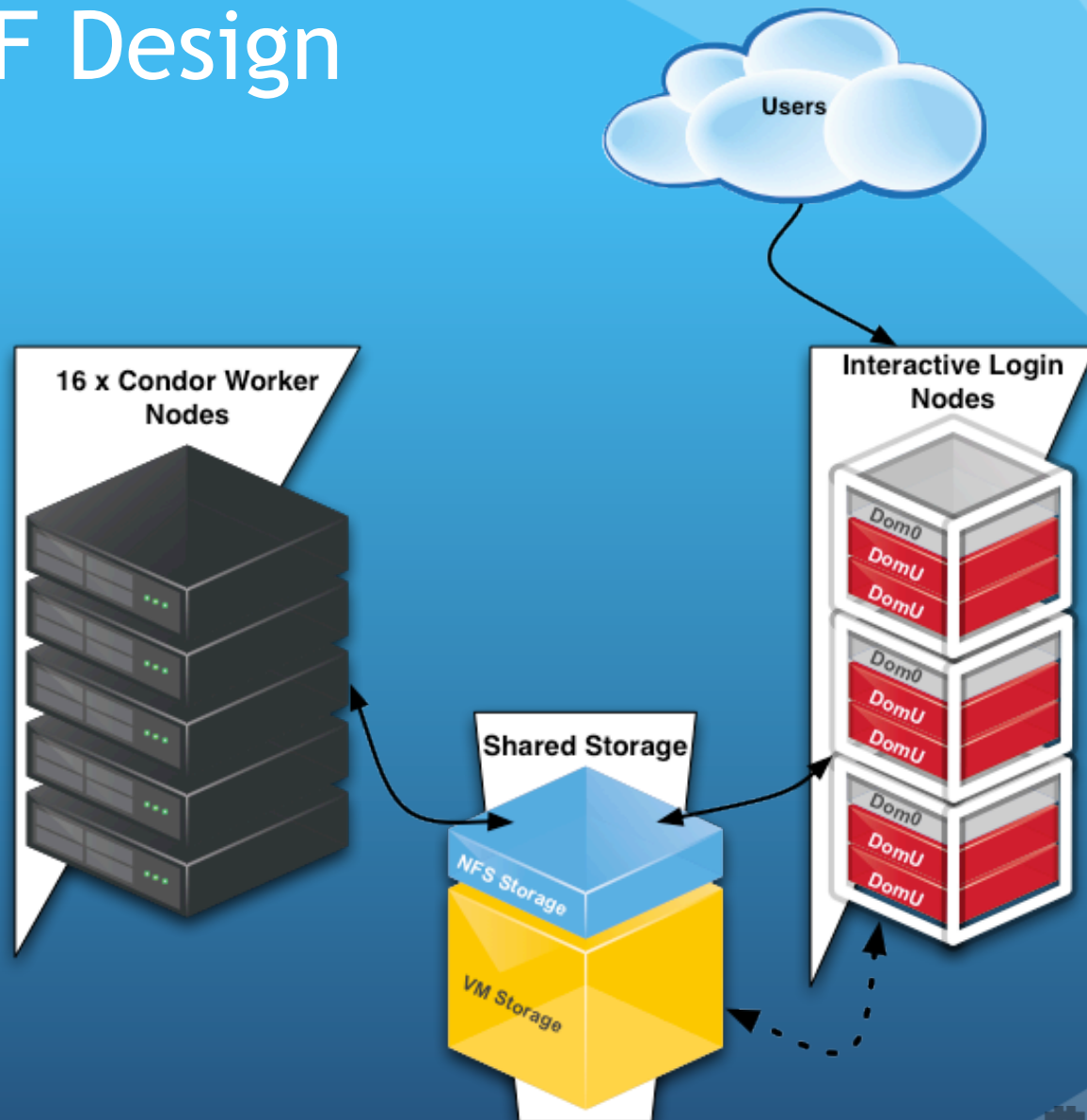
Misc Cluster Management Tools and Techniques

Other things you might find interesting

GPCF

- General Purpose Computing Facility

- Oracle VM cluster + batch cluster

- Quick provisioning for smaller or new experiments.

- Computing resources in days instead of weeks/months.

- Small batch cluster serves as training wheels for the Grid.
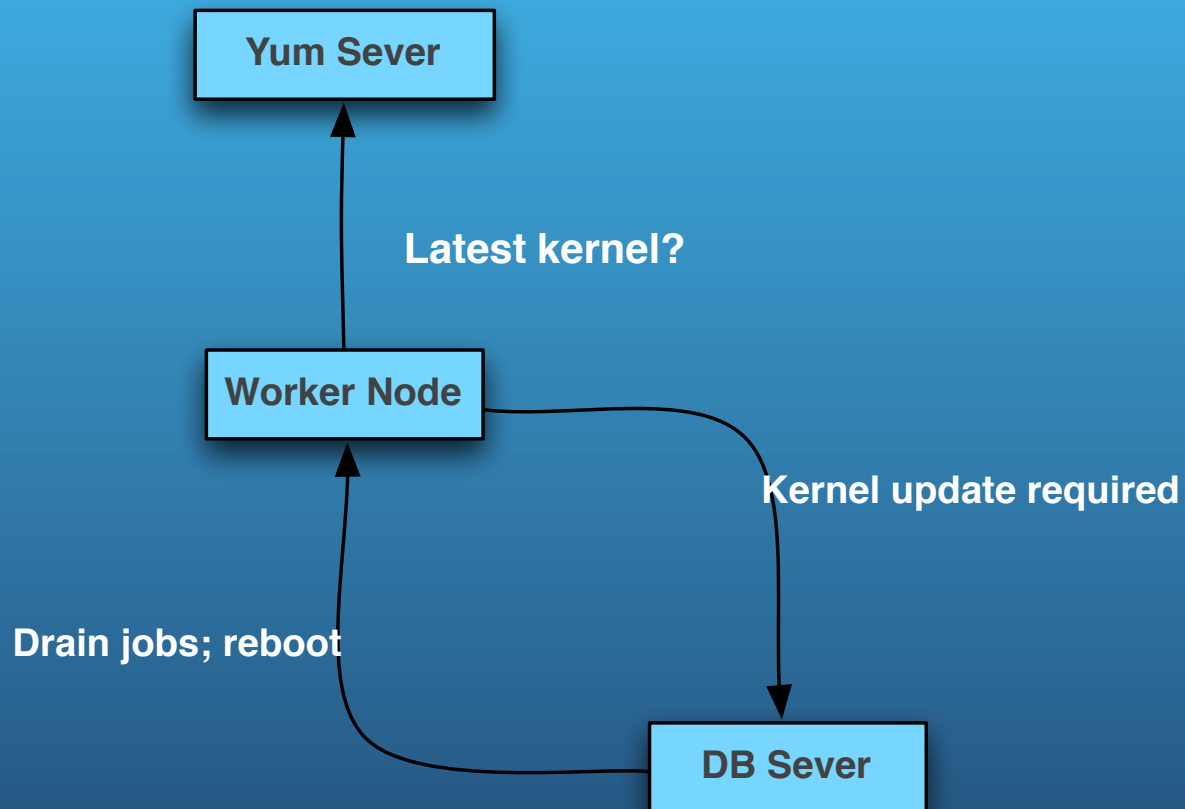
GPCF Design

CDF Grid Rolling Upgrades

- Fermi security policy states that software patches to be applied within 60 days of release.

- Systems must be every rebooted every 2-3 months to load new Linux kernel.

- Tool automatically drains and reboots 50 nodes at a time.

- 1K node cluster is updated in appox 2 weeks.

Rolling Upgrades

Conceptual Overview

Yum Sever

Latest kernel?

Worker Node

Kernel update required

Drain jobs; reboot

DB Sever

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Resources

Comparison of Puppet/Cfengine/Bcfg2
https://cd-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=3967

Evaluation and feature comparison of the Nagios and Zabbix monitoring systems

http://cd-docdb.fnal.gov/cgi-bin/ShowDocument?docid=3277

Download Scientific Linux 6

http://scientificlinux.org/

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Acknowledgements

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